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09/193,058	11/16/1998	ALBERT S. FENG	22010-127	1589

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EXAMINER
GRAHAM, ANDREW R

ART UNIT	PAPER NUMBER
2644	17

DATE MAILED: 08/27/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)
	09/193,058	FENG ET AL.
	Examiner	Art Unit
	Andrew Graham	2644

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 May 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *34,35,37-42,44-48,50-54 and 56* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *34,35,37-42,44-48,50-54 and 56* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Allowable Subject Matter

1. The indicated allowability of claims 36, 37, 39-42, 48, 49, and 51-54, as it relates to the now amended claims 34 and 46, is withdrawn in view of the newly discovered references of Bhadkamkar (USPN 6002776), and Lea (USPN 4601025), and Brandstein et al (UPSN 5581620). Rejections based on the newly cited references follow.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 34-35, 37-42, 44-48, 50-54, and 56** are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhadkamkar (USPN 6002776) in view of Lea (USPN 4601025) and Brandstein et al (USPN 5581620).

Bhadkamkar discloses a system for processing and distinguishing multiple input signal sound sources. The input to the system is provided through a pair of microphones (10,12)

(col. 5, lines 51-62). The acoustical inputs received through these microphones (10,12) are digitized into electrical signals (14,16), the contents of which include signals from two sources (A,B) (col. 6, lines 9-30). The use of the system in the presence of these two microphone signals equates to "detecting an acoustic excitation at both a first location to provide a corresponding first signal and at a second location to provide a corresponding second signal". The notion that this signal contains components from different sound sources reads on "the excitation being a composite of a desired acoustic signal from a first source and an interfering acoustic signal from a second source spaced apart from the first source" (col. 6, lines 27-30 and Figures 1,4). The system employs a Direction of Arrival (DOA) estimator (20) that provides direction of arrival information about each source, based on the microphone signals (col. 6, lines 13-18 and col. 17, lines 21-26). The time relationship between the signals associated with the sources is utilized to isolate the sound signals from each of the sources (col. 8, lines 18-25). This amount of delay is provided by the DOA estimator (20), which Bhadkamkar states is well known in the art (col. 8, lines 26-31). Thus, the function performed by the estimator (20), assessing the directions of arrival, reads on "determining location of the second sound source relative to the first source as a function of the first and second signals".

Regarding this DOA estimator (20), Bhadkamkar only teaches that it is well known in the prior art.

Therefore, Bhadkamkar does not clearly specify:

- that determining the location of relative sound sources includes delaying each of the first and second signals by several time intervals to provide several delayed first signals and several delayed second signals
- providing a time increment representative of the separation of the first source from the second source" (col. 8, lines 18-31).

Lea discloses a system for determining the horizontal and vertical angle of a target relative to two sets of sensors. The horizontal angle of a target relative to one set of receiving elements is based on the output of correlators (45) (col. 4, lines 59-66). The input to the correlator (45) involves applying the two input signals to opposite ends of delay lines (42,44) (col. 4, lines 24-30). The outputs of the delay lines are applied to correlators (46), wherein the pair of delayed signals that exhibits the maximum correlation indicates the angle of incidence of the arriving signal (col. 4, lines 33-49). This use of two delay lines for two received signals, as shown in Figure 4, reads on "delaying each of the first and second signals by several time intervals to provide several delayed first signals and several delayed second signals". The identification of a peak indication gives rise to the time differential between the angle of incidence of the received sound and the phase center of the two receiving elements (col. 4, lines 59-66). The

association of the delay value with a tap at which a peak correlation appears reads on "providing a time increment representative of the separation of the first source from the second source". Multiple sets of receiving elements are combined to determine the vertical angle of the target (col. 5, lines 2-10). Lea also teaches that multiple targets within a subarray beam may be resolved and tracked in regards to direction (col. 5, lines 21-32).

To one of ordinary skill in the art at the time the invention was made, it would have been obvious to incorporate an individual correlator system as taught by Lea as part of the DOA estimator of the system of Bhadkamkar to handle the two input signals from the microphones and determine the multiple sound source directions. The motivation behind such a modification would have been that such a correlator system is known in the art to provide a substantial degree of parallel processing, and require minimal control overhead in establishing the possible incident angles.

Output signals representing the differentiated input source signals are provided as part of the outputs of the system of Bhadkamkar (col. 6, lines 59-65).

However, Bhadkamkar in view of Lea does not specify:

- that this output is a generated characteristic signal representative of the desired acoustic signal during performance of said determining

- that this characteristic signal is a function of the time increment

However, signal processing in the frequency domain is substantially well known in the art. Brandstein discloses a system for enhancing the reception of signals at specified locations. Figure 1 illustrates that each of the input signals are digitized (18), windowed (20) according to a user selected length, and applied to time to frequency transform elements (22) (col. 6, lines 39-62). The transform elements (22) generate signals that represent the spectral content of the input signal (col. 7, lines 1-38). The processing disclosed by Brandstein involves the determining of a relative delay between signal channels, which includes the any of well known delay estimation techniques such as cross-correlation with peak picking (col. 8, lines 37-51). This delay is used in a calculation for aligning the particular input signal (68) to a reference signal (25) (col. 9, lines 36-54). The input signal (68) and the reference signal (25) are then combined to form an output signal (66) (col. 9, lines 54-57). This processing of a signal in the frequency domain, in view of the signal processing performed by Bhadkamkar, reads on "generating a characteristic signal representative of the desired acoustic signal during performing of said determining". Both of the signal processing schemes of Bhadkamkar and Brandstein involve the use of a relative time delay between signals, which, based on the directions of arrival,

reads on "the characteristic signal being a function of the time increment".

To one of ordinary skill in the art at the time the invention was made, it would have been obvious to incorporate the frequency transform and relative signal processing of Brandstein into the processing system of Bhadkamkar in view of Lea. The motivation behind such a modification would have been that processing in the frequency domain is well known in the art to allow for adaptive bit allocation, depending on a desired degree of frequency resolution. The relative signal processing would have been desirable because it would have enabled a target signal to be isolated and enhanced.

Regarding **Claim 35**, the formed output signal (66) in the system of Brandstein is a frequency domain represented signal that is processed by an frequency to time domain element (36) to create a time domain version of the output signal (66) (col. 10, lines 43-49). This signal format reads on "the characteristic signal corresponds to spectral content of the desired acoustic signal" (col. 7, lines 3-38, Brandstein). The processing by the inverse transform element (36) reads on "providing an output signal representative of the desired acoustic signal as a function of the characteristic signal" (col. 10, lines 43-49).

Regarding **Claim 37**, the correlation system of Lea includes dual delay elements (42,44), the function of which reads on "delaying each of the first and second signals by a number of time intervals to provide a number of delayed first signals and a

number of delayed second signals" (col. 4, lines 17-22). Corresponding taps from the delay elements (42,44) are connected to correlators (45), wherein the maximum correlation appears on the correlates output corresponding to a certain angle of incidence (col. 4, lines 26-49). This correspondence between delay taps reads on "establishing a signal pair, the signal pair having a first member from the delayed first signals and a second member from the delayed second signals". As stated above, Lea teaches that multiple sources can be tracked with such a device, and Bhadkamkar states that such direction of arrival devices are known in the art to provide relative time delays between signals. Both of the signal processing schemes of Bhadkamkar and Brandstein involve the use of such relative time delay between signals, which, based on the directions of arrival, reads on "the characteristic signal being a function of the time increment".

Regarding **Claim 38**, Brandstein teaches that the produced beam signal enhances the signal to noise ratio of sound signals generated from a source at the position of a target source (38) (col. 7, lines 59-64). The signal is finally processed by an inverse transform (36) (col. 10, lines 43-49). Such function reads on "providing an output signal representative of the desired acoustic signal". Bhadkamkar teaches that such sound source isolating systems may be used in a variety of applications, including voice activated devices and hearing aids (col. 5, lines 44-46). This reads on "the desired acoustic signal includes speech and the output signal is provided by a

hearing aid device". The human voice is also given an as example of a sound source by Brandstein (col. 1, lines 33-35).

Regarding **Claim 39**, the system of Brandstein includes sampling elements (18) connected to the input receivers (16) (col. 6, lines 39-52). The function of these components reads on "converting". The circuit of Brandstein also includes time-tofrequency domain transform elements (22), the function of which equates to "transforming" (col. 7, lines 3-38). Regarding the limitations of "delaying" and "establishing", please refer above to the rejection of similar limitations in Claims 34 and 37.

Regarding **Claim 40**, the input angle of a source is given by Equation 9a or 9b of Lea, which is $\cos(\theta)=(V*t)/L$, where t is a differential time, L is the length between sensors, and V is the speed of the wavefront (col. 3, lines 51-62). The concept of the source signal being associated with this angle, reads on "the characteristic signal corresponds to a fraction". The differential time corresponds to the paired delay taps, and in this equation, reads on "a numerator determined from at least the first and second members". Equation 13 illustrates that the delay applied with a delay component (41) corresponds to $T_D= (L* \cos(\theta_i))/V$, where θ_i corresponds to the angular phase center of the receiving elements, L again corresponds the length between sensors, and V is the speed of the wavefront (col. 4, lines 31-42). Lea teaches that the delays are chosen such that the outer, opposite taps correspond to the extreme ends of the input angle

range. In such a case, the delay applied to a signal in the first delay line (42) corresponds to this delay, T_D. Equation 13 can be rewritten as L= $(T_D*V)/\cos(\theta_I)$, and substituted for L of Equations 9a or 9b. In a maximum signal pair at the edge of the input beam range, this time delay, T_D, relates to the total delay provided by the delay lines. The teachings of these equations read on "a denominator determined from at least the first time increment", wherein, again, the first time increment is associated with a delay of a signal. For this particular claim, the examiner respectfully notes that further defining the fraction in this equation may overcome this rejection.

Regarding **Claim 41**, as stated above, the signal pair of Lea represents direction of arrival of a source, and Bhadkamkar teaches that such prior art direction of arrival devices involve determining and providing a relative time delay between signal sources (col. 8, lines 26-31 of Bhadkamkar). Such a relative time difference is utilized in both teachings of Bhadkamkar and Brandstein for producing the output signals, which reads on "determining", again, noting that the signals of Brandstein are processed in the frequency domain. Brandstein also teaches the use of an inverse frequency to time transform (36) for reformatting a processed signal (66) (col. 10, lines 43-49). This reads on "transforming". The application of such separated source signals in a hearing aid device, as taught by Bhadkamkar, involves the emission of such signals through speakers. Such

transducing reads on "providing", which the motivation for such being the audible use of processed signals by a user.

Regarding **Claim 42**, the taps in the delays (42,44) of Lea correspond to differential time delays (col. 4, lines 24-26 and 42-49). A centered signal has a peak correlation at both of the central taps of the delay lines, while a non-centered input signal will have a peak correlation at a tap on either side of the central tap (col. 4, lines 33-49). Determining this peak correlation, which involves the delays associated with the two taps, reads on "establishing a second time increment corresponding to separation of the first source from the second source by comparing the delayed first and second signals". Figure 4a of Lea shows a phase wavefront (33), wherein it can be seen that certain receivers (25) are positioned closer to this phase wavefront than other receivers (28) (col. 4, lines 1-9). The angle at which this phase front reaches the receivers is described as the beam peak, which is centered in the input field beam, θ_B, as the beam peak (col. 4, lines 31-42). Lea teaches that when the input signal direction does not correspond to this beam peak, the peak correlation appears at a tap on either side of the central tap (col. 4, lines 42-47). This arrival at a non-center tap, as it occurs for two different delay taps, reads on "wherein the first time increment corresponds to a first phase difference, the second time increment corresponds to a second phase difference". These two arrivals are used to determine the

direction of the sound source which, as stated above in regards to Bhadkamkar enables a relative time difference to be determined, upon which source signals are separated (col. 8, lines 1-31). This, in view of the frequency domain processing of Brandstein, reads on "the characteristic signal includes representation determined from at least the first and second phase differences".

Regarding **Claim 44**, Lea teaches that the length of the delay taps (S) corresponds to the overall width of the input field (col. 4, lines 49-56). Figure 5 illustrates this delay, depicted as a "fine delay", and numerous delay taps are illustrated for a depicted narrow beam width. Lea also teaches that that the tap at which a peak correlation appears is a function of the incident angle of the sound source. As stated above, Lea teaches that multiple sound sources may be tracked with such a system (col. 5, lines 21-32). The nature of these taps equates the resolution of the angular position of the sound source to the number of taps present in the system. Lea also expresses a desire for a higher target resolution than presented in previous applications (col. 2, lines 66-68 and col. 3, lines 1-2). For the depicted use, sonar detection, the resolution would have been particularly important because of the significant relative distance of source signals, as for distant sources, each increment of angular resolution corresponds to a longer arc of space. Collectively, the nature of the delays and the teachings of Lea equate to having a high degree of resolution. This nature, in view of the

fineness of applied delays, equates to having a significant number of delays, corresponding to "separation of the second source is within five degrees of the first source relative to a zero degree azimuthal reference axis intersecting the first source and a midpoint situated between the first and second locations", with the motivation behind such a characteristic being the higher resolution afforded.

Regarding **Claim 45**, Bhadkamkar teaches the establishment of two signals sources (A,B)(col. 6, lines 24-30), Lea discloses the tracking of multiple targets (col. 5, lines 21-32), and Brandstein teaches the use of multiple receivers to receive signals from a single direction that corresponds to a target source (38), which removes the noise or unwanted signals (col. 7, lines 56-64). Bhadkamkar particularly illustrates the positioning of the sound sources relative to the input signals (Figure 4). The taps of the system of Lea correspond to an angle of incidence. of Lea These teachings collectively read on "establishing a number of location signals each corresponding to a different location relative to the first source". In the system of Bhadkamkar, relative delay is used to eliminate one of the signals from an input signal with combined input content (col. 8, lines 1-25). This relative time delay is received from a direction of arrival estimator (20), with which the system of Lea is associated in the modification discussed above (col. 8, lines 26-31). In the system of Brandstein, the relative delay is used to align each of the inputs to the signal of a predefined

target source (col. 9, lines 7-34). As noted previously, the resulting signal of the system of Brandstein is represented in the frequency domain (col. 10, lines 43-49). The use of multiple input signals in the system to produce a single source signal based on the pairing of delayed inputs reads on "selecting the characteristic signal from the location signals", the use of a direction of arrival based relative time delay reads on "being representative of the location of the second source relative to the first source", and the frequency domain processing of an output signal in Brandstein reads on "including a spectral representation of the desired acoustic signal".

Regarding **Claim 46**, please refer above to the rejection of similar limitations of Claims 34, 37, and 45. Regarding **Claim 47**, please refer above to the rejection of the similar limitation of Claim 35. Regarding **Claim 48**, please refer above to the rejection of the similar limitations of Claims 34, 37, and 45. Regarding **Claim 50**, please refer above to the rejection of the similar limitations of Claim 38. Regarding **Claim 51**, please refer above to the rejection of the similar limitations of Claim 39. Regarding **Claim 52**, please refer above to the rejection of the similar limitation of Claim 40. Regarding **Claim 53**, please refer above to the rejection of the similar limitations of Claim 41. Regarding **Claim 54**, please refer above to the rejection of the similar limitations of Claim 42. Regarding **Claim 56**, please refer above to the rejection of the similar limitations of Claim 44.

Response to Remarks

Applicant's remarks with respect to claims 34-35, 37-42, 44-48, 50-54, and 56 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Bond et al (USPN 4267580) discloses delay-line based analog and digital correlators for use with communication, sonar, or frequency domain beamforming.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew Graham whose telephone number is 703-308-6729. The examiner can normally be reached on Monday-Friday, 8:30 AM to 5:00 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Isen can be reached on (703)305-4386. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

FORESTER W. ISEN
SUPERVISORY PATENT EXAMINER

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

AG

Andrew Graham

Examiner
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ag
August 10, 2004

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